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(54) **CABLE CONNECTOR ASSEMBLY HAVING SIMPLE WIRING ARRANGEMENT BETWEEN TWO END CONNECTORS**

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CPC ***H01R 12/73*** (2013.01); *H01R 12/62* (2013.01); *H01R 24/64* (2013.01)

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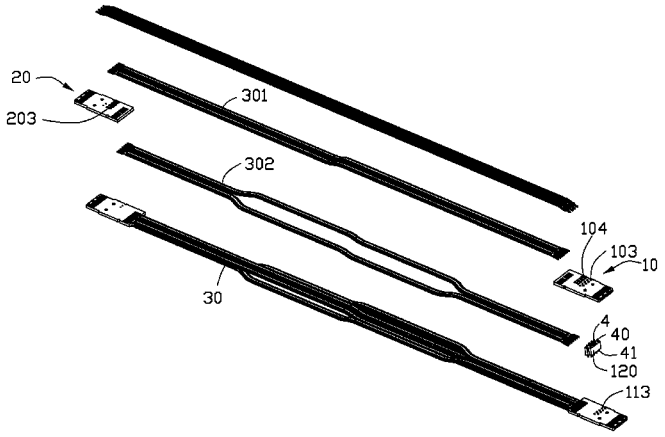
(57) **ABSTRACT**

A cable connector assembly includes a first connector, a second connector, and a cable connecting the first connector to the second connector. The first connector includes a first printed circuit board, a second printed circuit board, and a connecting member between the first and the second printed circuit boards. The second connector includes a third printed circuit board and a fourth printed circuit board. The cable includes a number of signal wires for transmitting data signals and a number of control wires for transmitting control signals. The control wires includes a number of first control wires connecting the first and the third printed circuit boards and a number of second control wires connecting the second and the fourth printed circuit boards.

20 Claims, 8 Drawing Sheets



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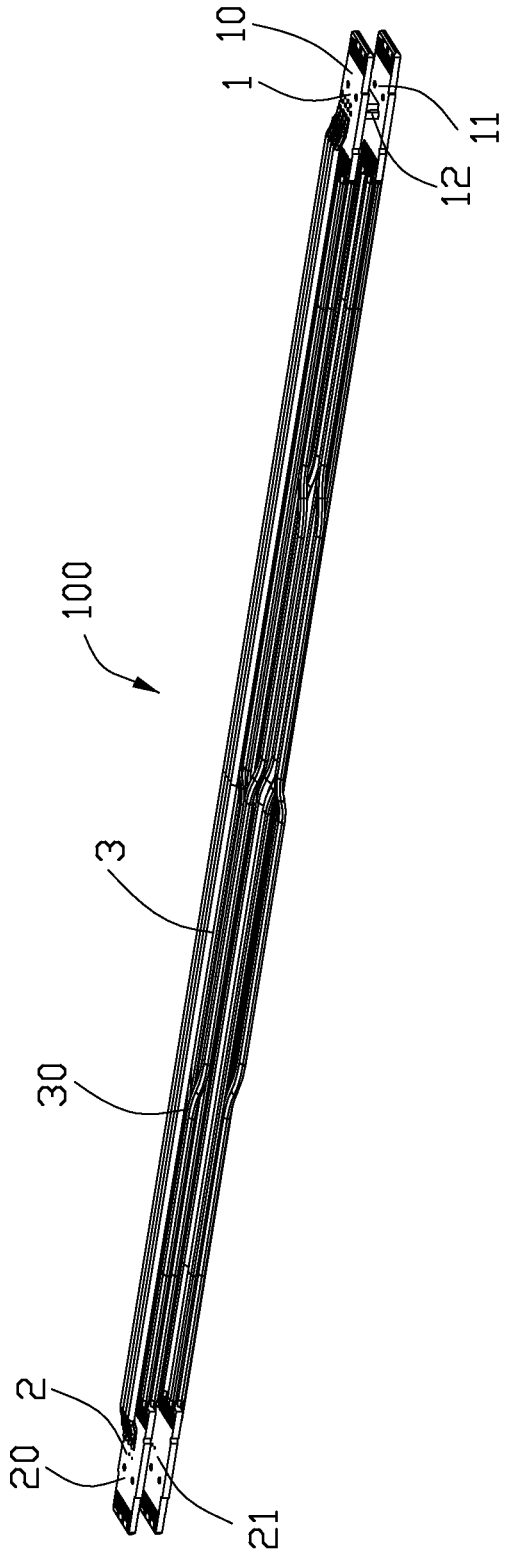

FIG. 1

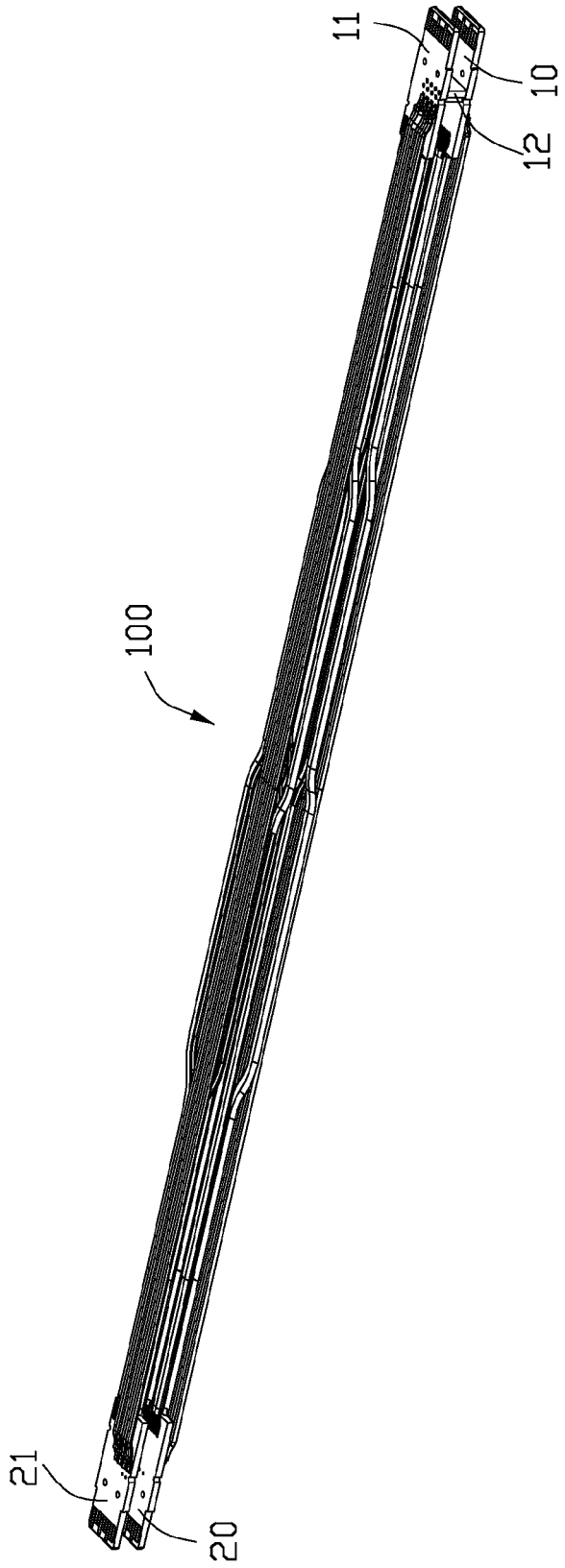

FIG. 2

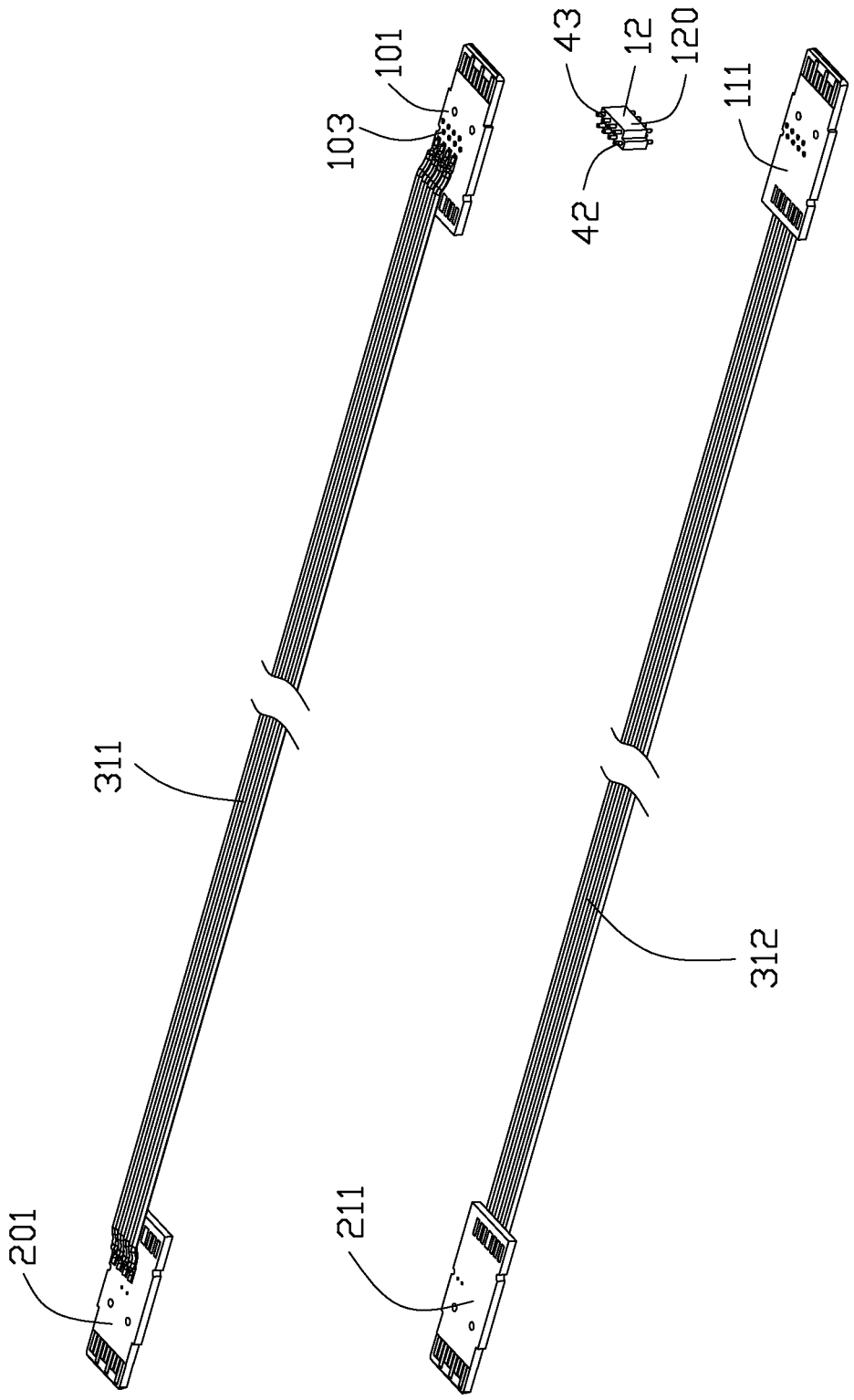

FIG. 3

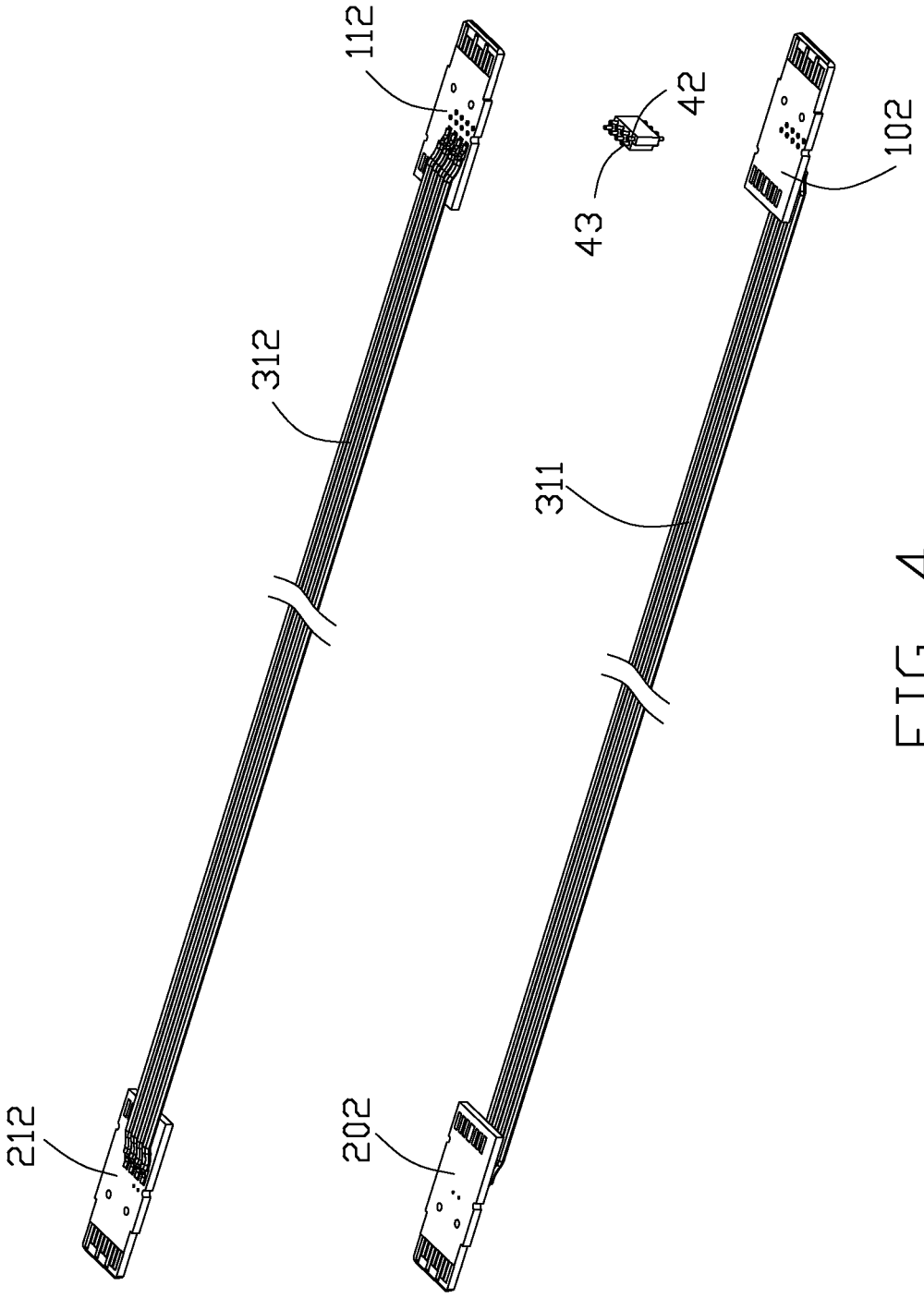

FIG. 4

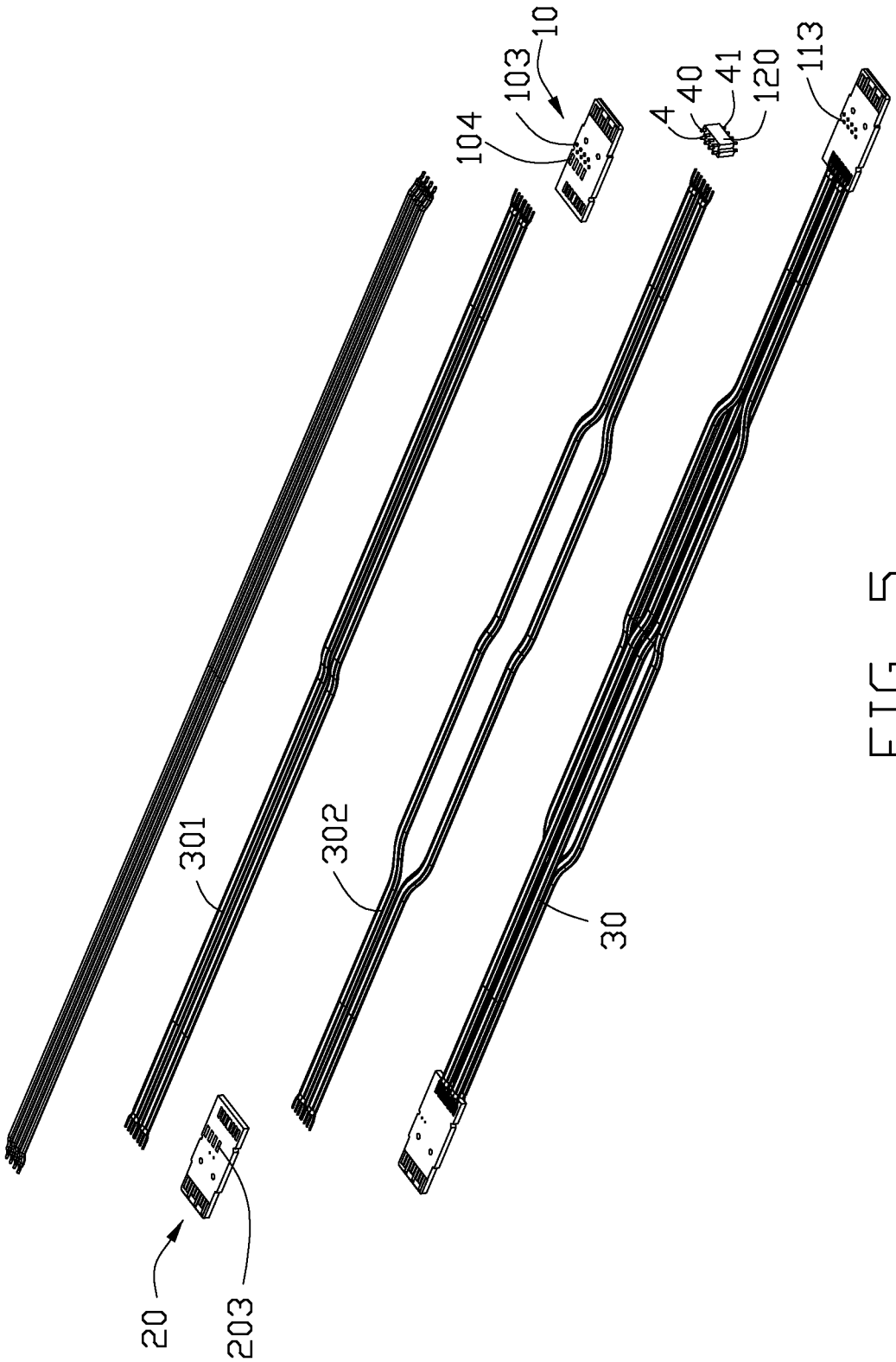

FIG. 5

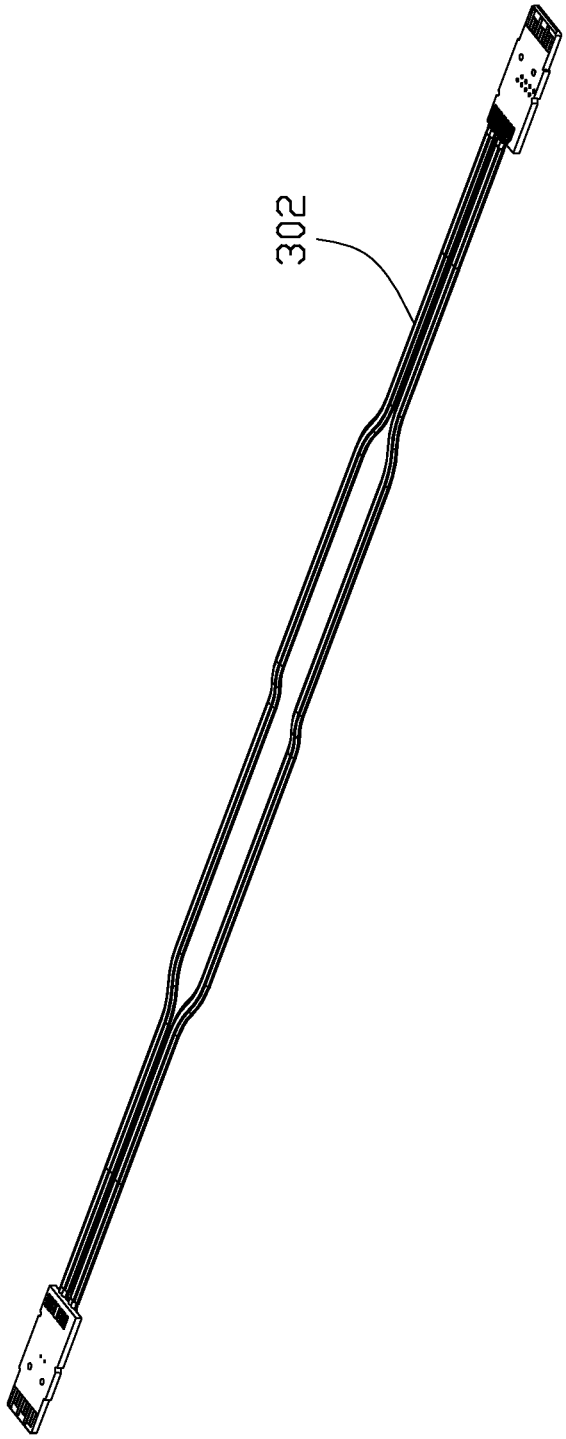

FIG. 6

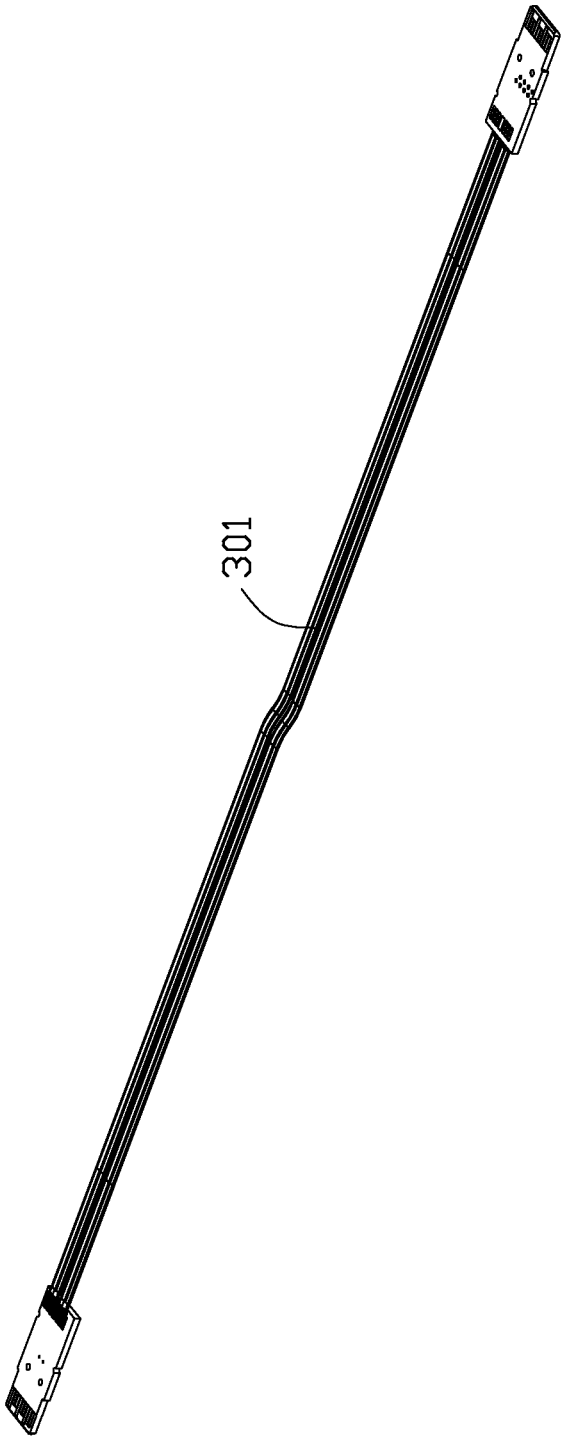

FIG. 7

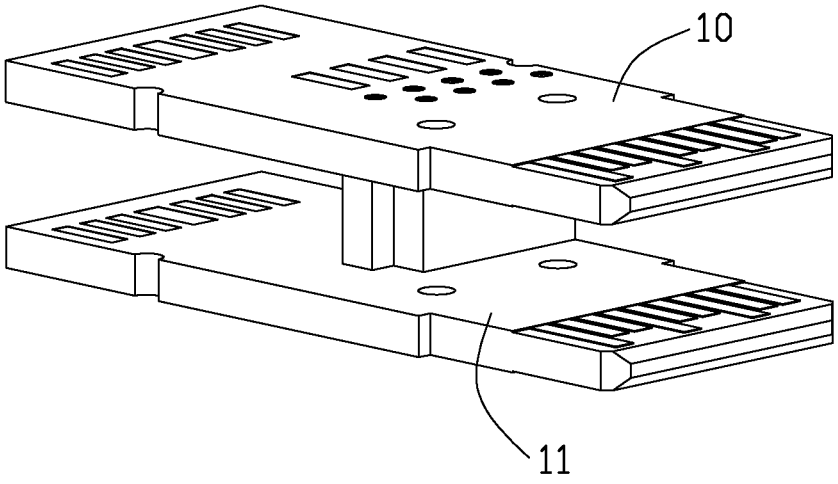

FIG. 8

CABLE CONNECTOR ASSEMBLY HAVING SIMPLE WIRING ARRANGEMENT BETWEEN TWO END CONNECTORS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a connector assembly, and more particularly to a signal transmitting structure of the connector assembly.

2. Description of Related Arts

It is known for a SAS (Serial Attached SCSI) External cable assembly to have a wiring arrangement that data signals are transmitted between a first cable end connector and a second cable end connector. In particular, the first connector comprises a first (upper) printed circuit board (PCB) and a second (lower) PCB, and the second connector comprises a third (upper) PCB and a fourth (lower) PCB. Data signals are transmitted straightforwardly between the second and the fourth PCBs and between the first and the third PCBs. Therefore, cable wires are soldered accordingly without cross-soldering, e.g., cable wires soldered to the second PCB of the first connector and to both the fourth and the third PCBs of the second connector.

The specification of SAS-3, revision of Apr. 23, 2012, showed a SAS Internal cable connector assembly comprising a first connector, a second connector, and a cable connecting the first connector to the second connector. The first connector comprises a first (upper) printed circuit board and a second (lower) printed circuit board. The second connector comprises a third (upper) printed circuit board and a fourth (lower) printed circuit board. The cable includes a plurality of signal wires for transmitting data signals and several control wires. The control wires between the first and the fourth printed circuit board are crossed from upper to lower; the control wires between the second and the third printed circuit board are crossed from lower to upper. The manufacturing process of soldering the crossed control wires is complicated.

U.S. Pat. No. 8,287,290, issued on Oct. 16, 2012, discloses an interface connector for electrically connecting a first circuit board to a second circuit board. The interface connector provides a bridge for electrical circuits associated with electrical components on the first board to connect with electrical circuits associated with electrical components on the second board.

An improved connector assembly is desired to offer advantages over the related art.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a cable connector assembly easy for soldering cable wires thereof.

To achieve the above-mentioned object, a cable connector assembly comprises: a first connector comprising a first printed circuit board (PCB), a second PCB below the first PCB, and a connecting member disposed between and electrically connecting the first PCB and the second PCB; a second connector comprising a third PCB and a fourth PCB below the third PCB; a cable connecting the first connector to the second connector, the cable comprising a plurality of signal wires for transmitting data signals and a plurality of control wires for transmitting control signals, the control wires comprising a plurality of first control wires connecting the first and the third PCBs and a plurality of second control wires connecting the second and the fourth PCBs.

According to the present invention, the connector assembly avoids the crossed soldering to simplify the manufacture procedure. It is more convenient because of using a flat cable instead of the core wires which are soldered separately.

Other objects, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a perspective view of a cable connector assembly in accordance with the present invention;

FIG. **2** is another perspective view of the connector assembly as shown in FIG. **1**;

FIG. **3** is a partly exploded view of the connector assembly as shown in FIG. **1**;

FIG. **4** is another partly exploded view of the connector assembly as shown in FIG. **3**;

FIG. **5** is another partly exploded view of the connector assembly as shown in FIG. **1**;

FIG. **6** is a perspective view of printed circuit boards connected to the signal wires of the connector assembly as shown in FIG. **1**;

FIG. **7** is a perspective view of printed circuit boards connected to another signal wires of the connector assembly as shown in FIG. **1**; and

FIG. **8** is a perspective view of printed circuit boards and the connecting member of the connector assembly as shown in FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference will now be made in detail to a preferred embodiment of the present invention.

Referring to FIG. **1**, a cable connector assembly **100** comprises a first connector **1**, a second connector **2**, and a cable **3** connecting the first connector **1** to the second connector **2**. Understandably, one of the first connector **1** and the second connector could be for an input purpose and the other for the output purpose, or in a reciprocal manner either wholly or partially. Anyhow, for easy illustration of the whole structural relation among the detailed components, the first connector **1** and the second connector **2** may be named respectively as the input connector and the output connector rather than using the order numerals.

Referring to FIGS. **1** to **3**, the first connector **1** comprises a first printed circuit board **10**, a second printed circuit board **11** spaced apart from and disposed below the first printed circuit board **10**, and a connecting member **12** electrically connecting the first and second printed circuit board **10**,**11**. The connecting member **12** is disposed between the first and the second printed circuit board **10**,**11**.

The first printed circuit board **10** comprises a first upper signal terminal **101** on an upper surface and a first lower signal terminal **102** on a lower surface of the first printed circuit board **10**. A plurality of first terminal holes **103** are formed by passing through the upper surface and the lower surface of the first printed circuit board **10**. A plurality of first conductive pads **104** are disposed behind the first terminal holes **103** on the first upper signal terminal **101**. The second printed circuit board **11** comprises a second upper signal terminal **111** on the upper surface and a second lower signal terminal **112** on the lower surface of the second printed circuit board **11**. A plurality of second terminal holes **113** are formed by passing through the upper surface and the lower surface of the second printed circuit board **11**. A plurality of second

conductive pads **114** are disposed behind the second terminal holes **113** on the second lower signal terminal **112**.

The connecting member **12** comprises a body portion **120**, a plurality of contacts **4** held in the body portion **120**. The contact **4** comprises a head portion **40** extending upwardly beyond a top of the body portion **120**, a tail portion **41** extending downwardly beyond a bottom of the body portion **120**, and a middle portion (not shown) connecting the head portion **40** and the tail portion **41**. Referring to FIG. **8**, the connecting member **12** is fixed between the first printed circuit board **10** and the second printed circuit board **11** by inserting the head portion **40** into the first terminal hole **103** and the tail portion **41** into the second terminal hole **113**. The contacts **4** comprise a plurality of first contacts **42** and a plurality of second contacts **43**. Each first contact **42** is staggered with the corresponding second contact **43**.

The second connector **2** comprises a third printed circuit board **20** and a fourth printed circuit board **21** spaced apart from and disposed below the third printed circuit board **20**. The third printed circuit board **20** comprises a third upper signal terminal **201** on the upper surface and a third lower signal terminal **202** on the lower surface of the third printed circuit board **20**. A plurality of third conductive pads **203** are disposed on the third upper signal terminal **201**. The fourth printed circuit board **21** comprises a fourth upper signal terminal **211** on the upper surface and a fourth lower signal terminal **212** on the lower surface of the fourth printed circuit board **21**. A plurality of fourth conductive pads **213** are disposed on the fourth lower signal terminal **213**.

The cable **3** comprises a plurality of signal wires **30** for transmitting the data signals and a plurality of control wires **31** for transmitting the control signals. Referring to FIGS. **5** to **7**, the signal wires **30** comprise a plurality of first signal wires **301** and a plurality of second signal wires **302**. The first signal wires **301** connect the upper surface of the first printed circuit board **10** and the lower surface of the third printed circuit board **20**. The second signal wires **302** connect the lower surface of the first printed circuit board **10** and the upper surface of the third printed circuit board **20**. The signal wires **30** soldered between the second printed circuit board **11** and the fourth printed circuit boards **21** are in the same way of the signal wires **30** soldered between the first printed circuit board **10** and the third printed circuit board **20**. The printed circuit boards are connected by the conductive pads disposed on the tail of the printed circuit boards.

Referring to FIGS. **3** to **4**, the control wires **31** comprise a plurality of first control wires **311** connecting the first and the third printed circuit board **10**,**20** and a plurality of second control wires **312** connecting the second and the fourth printed circuit board **11**,**21**. The control wires **31** have a flat shape. The first and the second control wires **311**,**312** are arranged independently.

The second upper signal terminal **111** electrically connects with the third lower signal terminal **202** through the first control wires **311** and the connecting member **12**. The second lower signal terminal **112** electrically connects with the third upper signal terminal **201** through the first control wires **311** and the connecting member **12**. The first upper signal terminal **101** electrically connects with the fourth lower signal terminal **212** through the second control wires **312** and the connecting member **12**. The first lower signal terminal **102** electrically connects with the fourth upper signal terminal **211** through the second control wires **312** and the connecting member **12**.

More specifically, the second upper signal terminal **111** connects with the third lower signal terminal **202** through the connecting member **12**, the first printed circuit board **10**, the first control wire **311** and the third printed circuit board **20**. The control signal from the second upper signal terminal **111** goes through the connecting member **12**, the first printed circuit board **10**, the first control wire **311**, the third printed circuit board **20** in turn and finally arriving in the third lower signal terminal **202**. The control signal from the third lower signal terminal **202** goes through the third printed circuit board **20**, the first control wire **311**, the first printed circuit board **10**, the connecting member **12** in turn and finally arriving in the second upper signal terminal **111**.

The second lower signal terminal **112** connects with the third upper signal terminal **201** through the second printed circuit board **11**, the connecting member **12**, the first printed circuit board **10** and the first control wire **311**. The control signal from the second lower signal terminal **112** goes through the second printed circuit board **11**, the connecting member **12**, the first printed circuit board **10**, the first control wire **311** in turn and finally arriving in the third upper signal terminal **201**. The control signal from the third upper signal terminal **201** goes through the first control wire **311**, the first printed circuit board **10**, the connecting member **12**, the second printed circuit board **11** in turn and finally arriving in the second lower signal terminal **112**.

The first upper signal terminal **101** connects with the fourth lower signal terminal **212** through the first printed circuit board **10**, the connecting member **12**, the second printed circuit board **11** and the second control wire **312**. The control signal from the first upper signal terminal **101** goes through the first printed circuit board **10**, the connecting member **12**, the second printed circuit board **11**, and the second control wire **312** in turn and finally arriving in the fourth lower signal terminal **212**. The control signal from the fourth lower signal terminal **212** goes through the second control wire **312**, the second printed circuit board **11**, the connecting member **12**, and the first printed circuit board **10** in turn and finally arriving in the first upper signal terminal **101**.

The first lower signal terminal **102** connects with the fourth upper signal terminal **211** through the connecting member **12**, the second printed circuit board **11**, the second control wire **312** and the fourth printed circuit board **21**. The control signal from the first lower signal terminal **102** goes through the connecting member **12**, the second printed circuit board **11**, the second control wire **312**, and the fourth printed circuit board **21** in turn and finally arriving in the fourth upper signal terminal **211**. The control signal from the fourth upper signal terminal **211** goes through the fourth printed circuit board **21**, the second control wire **312**, the second printed circuit board **11**, and the connecting member **12** in turn and finally arriving in the first lower signal terminal **102**.

when assembling the connector assembly, firstly, fix the connecting member **12** between the first and the second printed circuit board **10**,**11**. The head portion **40** is inserted into the first terminal holes **103** of the first printed circuit board **10** and the tail portion **41** is inserted into the second terminal holes **113** of the second printed circuit board **11**. Secondly, solder one side of the first signal wires **301** to the upper surface of the first printed circuit board **10** and another side to the lower surface of the third printed circuit board **20**. Solder one side of the second signal wires **302** to the lower surface of the first printed circuit board **10** and another side to the upper surface of the third printed circuit board **21**. The signal wires **30** between the second and the fourth printed circuit board are the same. Then solder the one side of the first control wires **311** to the first conductive pads **104** of the first printed circuit board **10**, and another side to the third conductive pads **203** of the third printed circuit board **20**. Solder one side of the second control wires **312** to the second conductive

pads **114** of the second printed circuit board **11**, and another side to the fourth conductive pads **213** of the fourth printed circuit board **21**.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A cable connector assembly comprising:

a first connector comprising a first printed circuit board (PCB), a second PCB below the first PCB, and a connecting member disposed between and electrically connecting the first PCB and the second PCB;

a second connector comprising a third PCB and a fourth PCB below the third PCB;

a cable connecting the first connector to the second connector, the cable comprising a plurality of signal wires for transmitting data signals and a plurality of control wires for transmitting control signals, the control wires comprising a plurality of first control wires connecting the first and the third PCBs and a plurality of second control wires connecting the second and the fourth PCBs.

2. The connector assembly as recited in claim **1**, wherein the control wires have a flat shape.

3. The connector assembly as recited in claim **2**, wherein the first and the second control wires are arranged independently.

4. The connector assembly as recited in claim **3**, wherein:

the second PCB comprises an upper signal terminal on an upper surface thereof and a lower signal terminal on a lower surface thereof;

the third PCB comprising an upper signal terminal on an upper surface thereof and a lower signal terminal on a lower surface thereof;

the upper signal terminal of the second PCB electrically connected with the lower signal terminal of the third PCB through the first control wires and the connecting member;

the lower signal terminal of the second PCB electrically connected with the upper signal terminal of the third PCB through the first control wires and the connecting member;

the first PCB comprising an upper signal terminal on an upper surface thereof and a lower signal terminal on a lower surface thereof;

the fourth PCB comprising an upper signal terminal on an upper surface thereof and a lower signal terminal on a lower surface thereof;

the upper signal terminal of the first PCB electrically connected with the lower signal terminal of the fourth PCB through the second control wires and the connecting member; and

the lower signal terminal of the first PCB electrically connected with the upper signal terminal of the fourth PCB through the second control wires and the connecting member.

5. The connector assembly as recited in claim **4**, wherein the connecting member comprises a body portion and a plurality of contacts held in the body portion, the contact comprising a head portion extending upwardly beyond a top of the body portion, a tail portion extending downwardly beyond a bottom of the body portion, and a middle portion connecting the head portion and the tail portion.

6. The connector assembly as recited in claim **5**, wherein the lower signal terminal of the second PCB connects with the upper signal terminal of the third PCB through the second PCB, the connecting member, the first PCB, and the first control wire.

7. The connector assembly as recited in claim **5**, wherein the upper signal terminal of the second PCB connects with the lower signal terminal of the third PCB through the connecting member, the first PCB, the first control wire, and the third PCB.

8. The connector assembly as recited in claim **7**, wherein the upper signal terminal of the first PCB connects with the lower signal terminal of the fourth PCB through the first PCB, the connecting member, the second PCB, and the second control wire.

9. The connector assembly as recited in claim **6**, wherein the lower signal terminal of the first PCB connects with the upper signal terminal of the fourth PCB through the connecting member, the second PCB, the second control wire, and the fourth PCB.

10. An electrical connector assembly comprising:

an output connection device including a first output PCB (Printed Circuit Board) and a second output PCB structurally spaced from each other while mechanically; and

an input connection device spaced from the output connection device while mechanically and electrically linked to said output connection device via a cable set, said input connection device including a first input PCB and a second input PCB spaced from each other;

an electrical connecting member mechanically and electrically connected either between the first output PCB and the second output PCB of the output connection device, or between the first input PCB and the second input PCB of the input connection device;

said cable set including a first set of cable mechanically and electrically linked between said first output PCB and said first input PCB, and a second set of cable mechanically and electrically linked to said second output PCB and said second input PCB; and

the first set of cable including a plurality of first control wires, the second set of cable including a plurality of second control wires, said first control wires and said second control wires being not intersected with each other while switching control signals which are transmitted by both said first control wires and said second control wires from the first input PCB to the second output PCB and from the second input PCB to the first output PCB, via said connecting member.

11. The electrical connector assembly as claimed in claim **10**, wherein the connecting member is located between the first output PCB and the second output PCB so as to have said first control wires electrically connected to said second output PCB and have said second control wires electrically connected to said first output PCB via said connecting member.

12. The electrical connector assembly as claimed in claim **10**, where said connecting member is of one piece with two groups of terminals respectively cooperating with said first set of cable and said second set of cable.

13. The electrical connector assembly as claimed in claim **10**, wherein said first set of cable further includes a plurality of first signal wires which are divided into two groups intersected with each other in a direction along which two opposite surfaces of the first output PCB or the first input PCB are spaced from each other.

14. The electrical connector assembly as claimed in claim 13, wherein said two groups are further intersected with each other in another direction perpendicular to said direction.

15. The electrical connector assembly as claimed in claim 13, wherein the first control wires are located on an outer side with regard to the first signal wires in said direction.

16. The electrical connector assembly as claimed in claim 13, wherein said second set of cable further includes a plurality of second wires which are divided into two groups intersected with each other in a direction along which two opposite surfaces of the second output PCB or the second input PCB are spaced from each other, and the first control wires cooperate with the second control wires to commonly sandwich both said first signal wires and said second signal wires therebetween in the direction.

17. The electrical connector assembly as claimed in claim 13, wherein the first signal wires are connected to the first output PCB at a position behind another position where the first control wires are connected.

18. An electrical connector assembly comprising:

opposite input and output PCBs (Printed Circuit Boards) linked to each other via a cable set, said cable set including a plurality of control wires and a plurality of signal wires, the control wires commonly connected to only one surface of the input PCB and only one surface of output PCB while the signal wires connected to both opposite two surfaces of the input PCB and both opposite two surfaces of the output PCB; wherein

said signal wires are divided into two groups intersected with each other in a vertical direction so as to switch connection positions on said two opposite surfaces of the input PCB to said two opposite surfaces of the output PCB in a reverse manner.

19. The electrical connector assembly as claimed in claim 18, wherein said two groups are further intersected with each other in a lengthwise direction along which said inner PCB and said output PCB are spaced from each other.

20. The electrical connector assembly as claimed in claim 18, further including a connecting member mounted upon one of the input PCB and the output PCB so as to electrically connect the control wires to the other surface of the output PCB.

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